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THE DISTRIBUTION AND BIONOMICS OF ARCTIC-ALPINE *LYCAENA PHLAEAS* SUBSPECIES IN NORTH AMERICA

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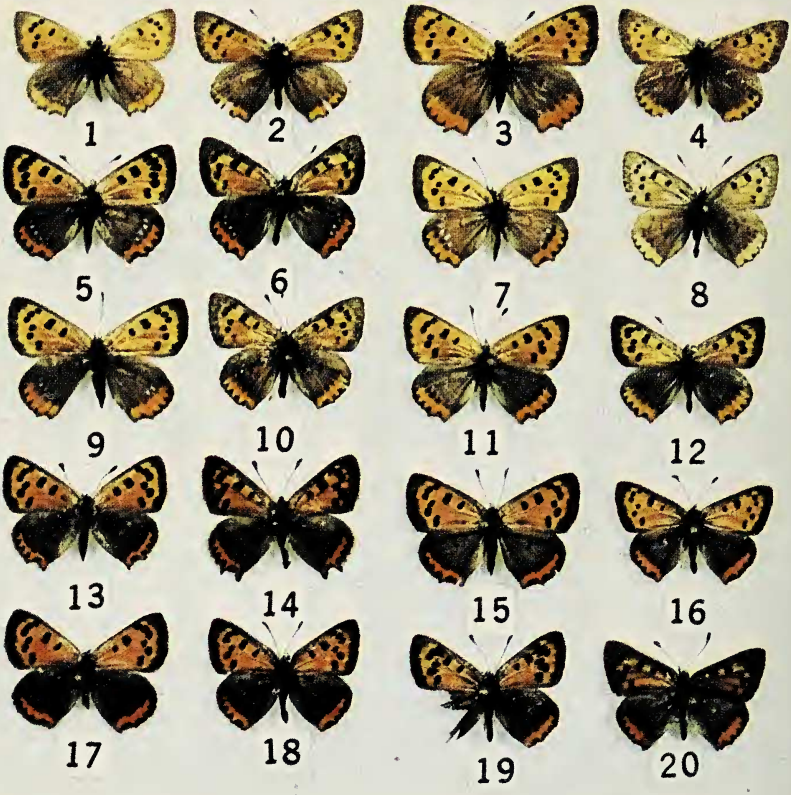
INTRODUCTION

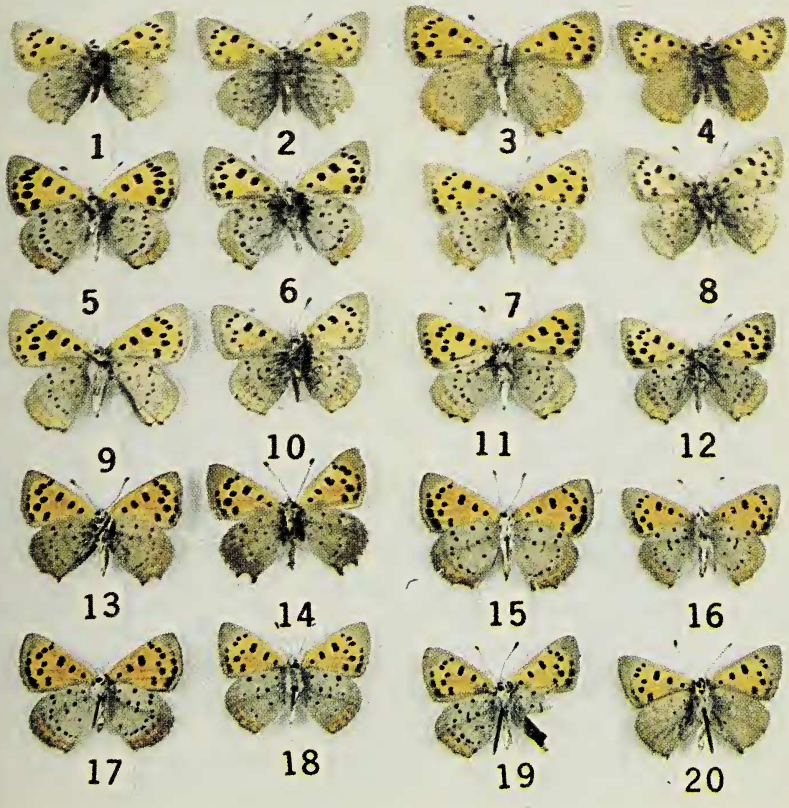
Ford (1923) defines the range of *Lycaena phlaeas* (Linnaeus) and its subspecies as "throughout the greater part of the Northern Hemisphere," including most of the Palaearctic and Nearctic Regions and part of the Oriental and Ethiopian Regions. The species is subject to remarkable seasonal, geographical, and individual variation within this range (Ford, 1923). In spite of this variation, the haploid chromosome number for three subspecies of *L. phlaeas* from Japan, Finnland, and the United States is 24 (Maeki & Remington, 1960), strongly indicating a stable chromosome number for the species throughout its range. Lees (1963) has shown that a changed environment can radically alter the phenotype of *phlaeas.*

TYPE LOCALITIES

Linnaeus (1761) described *L. phlaeas* from "in pratis Westmanniae." Westmannia is located in Sweden (Tite, 1957). Boisduval (1852) described *L. p. hypophlaeas* from "Nord de la Californie. Il se retrouve dans tout le nord des Etats-Unis." This translates, "North of California. It is found in all the northern United States" (Dod, 1907). Thus the type locality is not "California" as listed by Klots (1951) and Comstock & Huntington (1960) and alluded to by Forbes (1960) and Garth & Tilden (1963). We do not know of a precise locality for *hypophlaeas* nor where the type specimen(s) is located. (California material



Figs. 1 and 2. *Lycaena phlaeas feildeni*, 1, 2; *phlaeas* ssp., 3-10; *p. "hypophlaeas,"* 11, 12; *phlaeas*, 13, 14; *p. americana*, 15-18; *p. americana* f. *fasciata*, 19; *p. arethusa*, 20. 1. & 2. Clyde Inlet, Baffin Id., N.W.T. (BMNH), ♀, ♂. 3. & 4. McKinley Park, Alaska (AMNH), ♀, ♂. 5. & 6. ½ mi. W. Halfmoon Park, Crazy Mtns., Sweet Grass Co., Montana, ♀, ♂. 7. & 8. Bear Tooth Mtns., Carbon Co., Montana (AMNH), ♀,



♂. 9. Amphitheater Lake, 10,000', Grand Tetons, Wyoming (CU), ♀. 10. Beartooth Lake, Wyoming (CU), ♂. 11. & 12. N. slope Mt. Dana, 11,000-12,000', Mono Co., California, ♀, ♂. 13. & 14. Uddevalla, Sweden (BMNH), ♀, ♂. 15. & 16. Near Prairie Village, Johnson Co., Kansas, ♀, ♂. 17., 18., & 19. Camp Lucerne, Waushara Co., Wisconsin, ♀, ♂, ♂. 20. Plateau Mt. 8200', Alberta, ♂.

Fig. 3. Map of the North American *Lycaena phlaeas* subspecies distribution (excluding *americana*). Localities indicated by black dots. Shaded portion is the distribution of *Oxyria digyna* as figured by Mooney & Billings (1961) and Billings (in litt.).

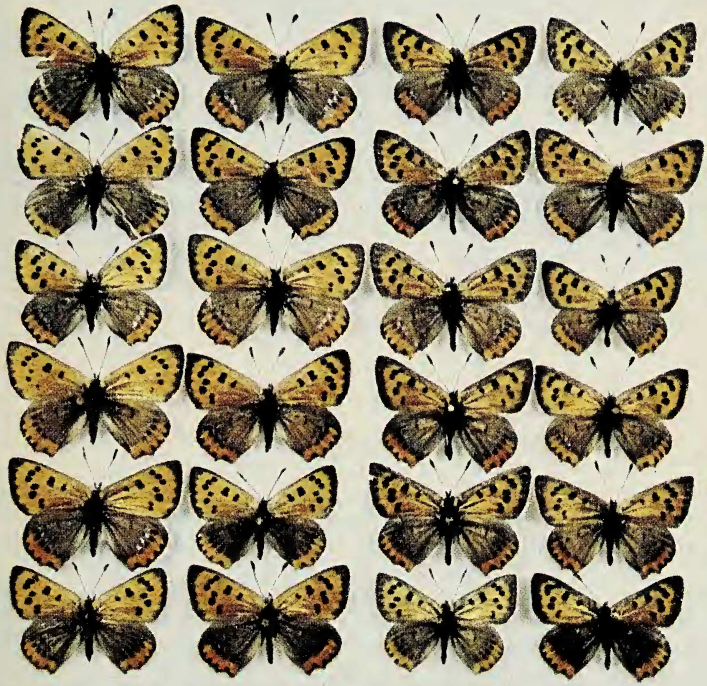


Fig. 4. Variation of *"hypophlaeas"* series from N. slope Mt. Dana, Mono Co., California. Left half females, right half males.

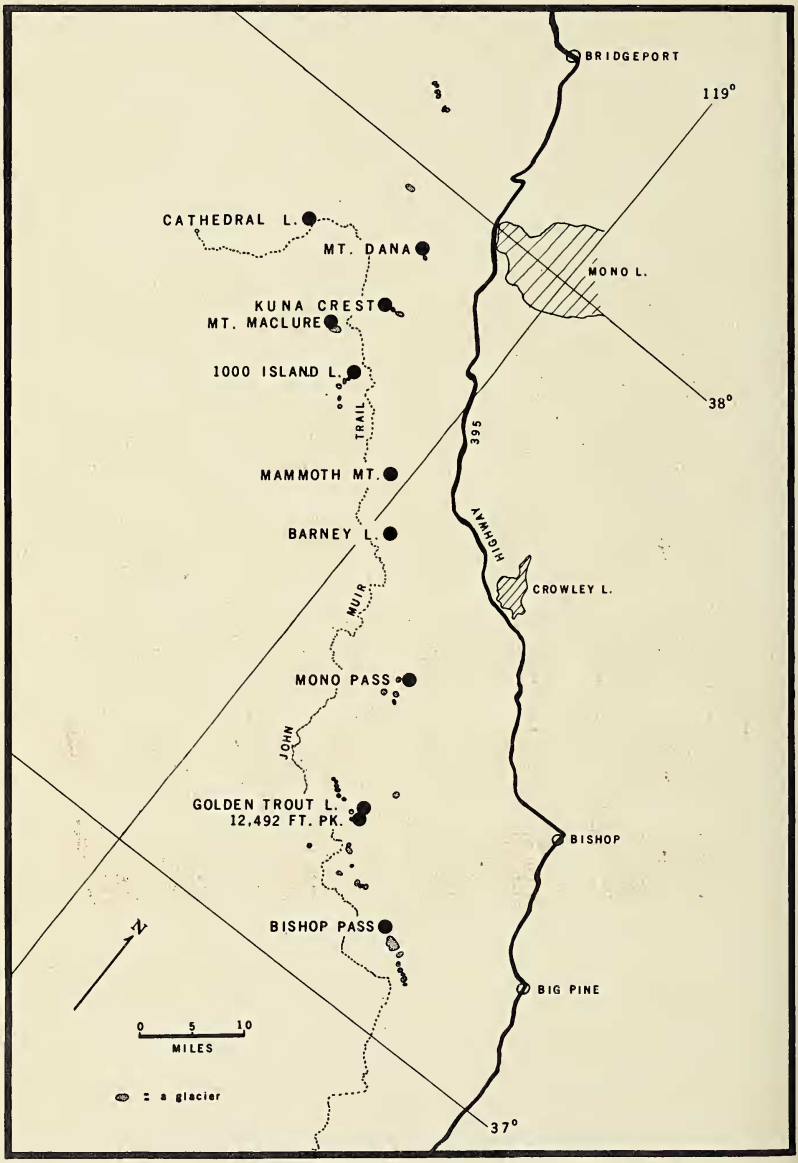


Fig. 5. Map showing the distribution of *"hypophlaeas"* in the Sierra Nevada Mtns., California. Localities indicated by black dots. Map adapted from Starr (1956).

will be referred to as *"hypophlaeas"* in this paper as a matter of convenience.) M'Lachlan (1878) described *L. p. feildeni* from two males and one female from "Lat. 81° 45'." The British Museum of Natural History contains these three specimens which bear the label, "Grinnell Land, west side of Smith Sound, Arctic America. 78-83 Lat. (81-45) Capt. Feilden R. N. 77-101." (Tite, in litt.). These were collected in 1875 or 1876 (Wolff, 1964). Dod (1907) described *arethusa* from five males and eight females: one male from ca. 35 mi. SW Calgary, Alberta (Lineham's lower log camp, S. Fork Sheep Creek), and the rest from ca. 25 or 20 mi. SW Calgary ("near the spruce woods"), July 5 to 20 (no years given). The holotype and allotype are in the United States National Museum, and six paratypes are in the Canadian National Museum.

FOOD PLANTS

Langer (in litt.) mentions that European texts list *Rumex* and *Polygonum* as larval foodplants for *phlaeas* forms. Yokoyama (1955) lists "daikon" (a type of garden radish) and various grasses as larval foodplants for *Lycaena phlaeas daimio* Seitz in Japan. This was the only reference we found that listed foodplants other than members of Polygonaceae for *phlaeas* subspecies. *Rumex* species are given as foodplants for *L. p. americana* Harris in various U. S. texts (see Davenport & Dethier, 1937; Klots, 1951). The only reference we found to a foodplant of the three subspecies studied was that of M'Lachlan (1878) to *Oxyria*. He suggested that *Oxyria digyna* (L.), then known as *O. reniformis*, probably serves as the foodplant for *feildeni* since no *Rumex* was found "at all the stations" while *Oxyria* was. Wyatt (in litt.) found *feildeni* at Coppermine, N. W. T., always in association with "a very *Rumex*-like plant" with reddish seeds and 6-8 inches high.

The foodplant for *"hypophlaeas"* in the Sierra Nevada Mountains of California is almost certainly *Oxyria digyna*, Mountain Sorrel, although evidence at present is circumstantial. No specimens of *"hypophlaeas"* were found by us more than a quarter mile from *O. digyna*. Both of us independently have seen females slowly flutter over *digyna* plants (one was seen doing so at 12:35 P.S.T., July 28, 1966, Mt. Dana, Mono County) and repeatedly alight on the flower heads without feeding. One female on August 4, 1964, Mt. Dana, walked extensively on a *digyna* plant. No such activity by females was seen directed toward other plants. However, no oviposition or abdominal

probing by these females was seen. At the Mt. Dana locality, no *Rumex* was found growing on the slopes where *"hypophlaeas"* flies. Flying, feeding, and sunning of both sexes were confined to the extensive *digyna* colony there. One of us (JCM) found *"hypophlaeas"* in four or five localities where *digyna* was found.

The distribution of *O. digyna* is characterized by Mooney & Billings (1961) as "arctic-alpine circumpolar, with disjunct locations far to the south in the mountains of Europe, Asia, and North America." The North American range of *digyna,* as figured by them, encompasses the known localities for *arethusa, feildeni,* and *"hypophlaeas"* (see fig. 3).

Mooney & Billings (1961) found that *O. digyna* in North America can be classed into two primary morphological groups. Based on stamen number, inflorescence branch number, and presence or absence of rhizomes, one group includes "all the populations from southern Alberta southward in an area largely to the south of maximum Pleistocene continental glaciation. The other group includes all of the northern populations (p. 27)." Presuming that *digyna* is the foodplant for the subspecies considered here, *arethusa* and *"hypophlaeas"* would correspond to the southern *digyna* populations, and *feildeni* would correspond to the northern populations. (We do not rule out the possibility that these populations may have other larval foodplants.)

Klots (1951) lists *Rumex acetosella* L. and "perhaps" *R. acetosa* L. and *R. crispus* L. as larval foodplants for *L. p. americana.* These are all introduced weeds from Europe and Asia (Fernald, 1950; Munz & Keck, 1965). In California, *R. acetosella* is found in cismontane areas, and *R. crispus* is found in low areas (Munz & Keck, 1965). The California *"hypophlaeas"* apparently has not extended its range into the habitats of these two weeds.

HABITAT

One of us (JCM) found adult feeding confined to a small yellow composite at four localities for *"hypophlaeas."* The other (OS) found feeding by both sexes at the Mt. Dana locality occurring on a number of small alpine flowers and a large yellow composite. At all localities we checked, the males often flew rapidly over the steep talus slopes and alighted to sun themselves on rocks; most of the females were collected while feeding on flowers. Both sexes perched on rocks and sunned either toward or away from the sun. One male on July 28, 1966, Mt. Dana, 11:20 P.S.T., lit on an *O. digyna* flower head momentarily.

MacNeill (in litt.) says that *"hypophlaeas"* at Mono Pass, Mono Co., California, is partial to the rocky "nunatak"-like plateaus

of gentle relief and the slopes of these near their base in the small canyons and chutes.

One of us (JCM) twice took *"hypophlaeas"* in conjunction with *Lycaena cupreus* (Edwards) and *L. editha* (Mead). Neither of these species flew directly with *"hypophlaeas"* at the Mt. Dana locality (see fig. 6), although both did fly some 500 feet lower in elevation to the west.

Legge (in litt.) says that *arethusa* at Plateau Mt. in Alberta is found in small grassy meadows, while *L. cupreus snowi* (Edwards, will fly over the talus as near as few hundred feet away.

Scott (in litt.) says that *phlaeas* ssp. at Halfmoon Park, Sweet Grass Co., Montana, flew in the Hudsonian zone; these were taken on a rocky jeep road in the trees below a barren rockslide.

ADULT MORPHOLOGY

The British Museum of National History contains one male and three females of a *phlaeas* form labelled "California, Felder Colln." These specimens are very similar to Eastern U. S. *americana* except that the upper forewing spots are elongated inward. An aberration of *americana* named *fasciata* (Strecker, 1878) has these elongated spots (see no. 18, fig. 1). Brower & Brower (1954) obtained *fasciata* individuals under uncontrolled rearing conditions and speculated that the condition is genetically determined. Lees (1963), however, produced this form environmentally. He reared ten *L. phlaeas* from Ilkley, England, at 35° C., a temperature much higher than the insect normally encounters. His description and illustration of the female adults correspond closely to the B.M.N.H. California specimens. No such ruddy coloration or spot formation was noted in 104 *"hypophlaeas"* specimens we have examined from the Sierra Nevada Mountains. Perhaps the four Felder specimens came from a warm habitat or were reared under heated conditions.

Figures 1 and 2 illustrate geographical variation in North American *L. phlaeas*. Certainly long series from many places coupled with experiments to determine how much of the variation may be due to environmental influences will be necessary to establish the status of the names *arethusa, feildeni,* and *hypophlaeas*. Figure 4 illustrates the variation in one population of *"hypophlaeas"* collected on three different years .

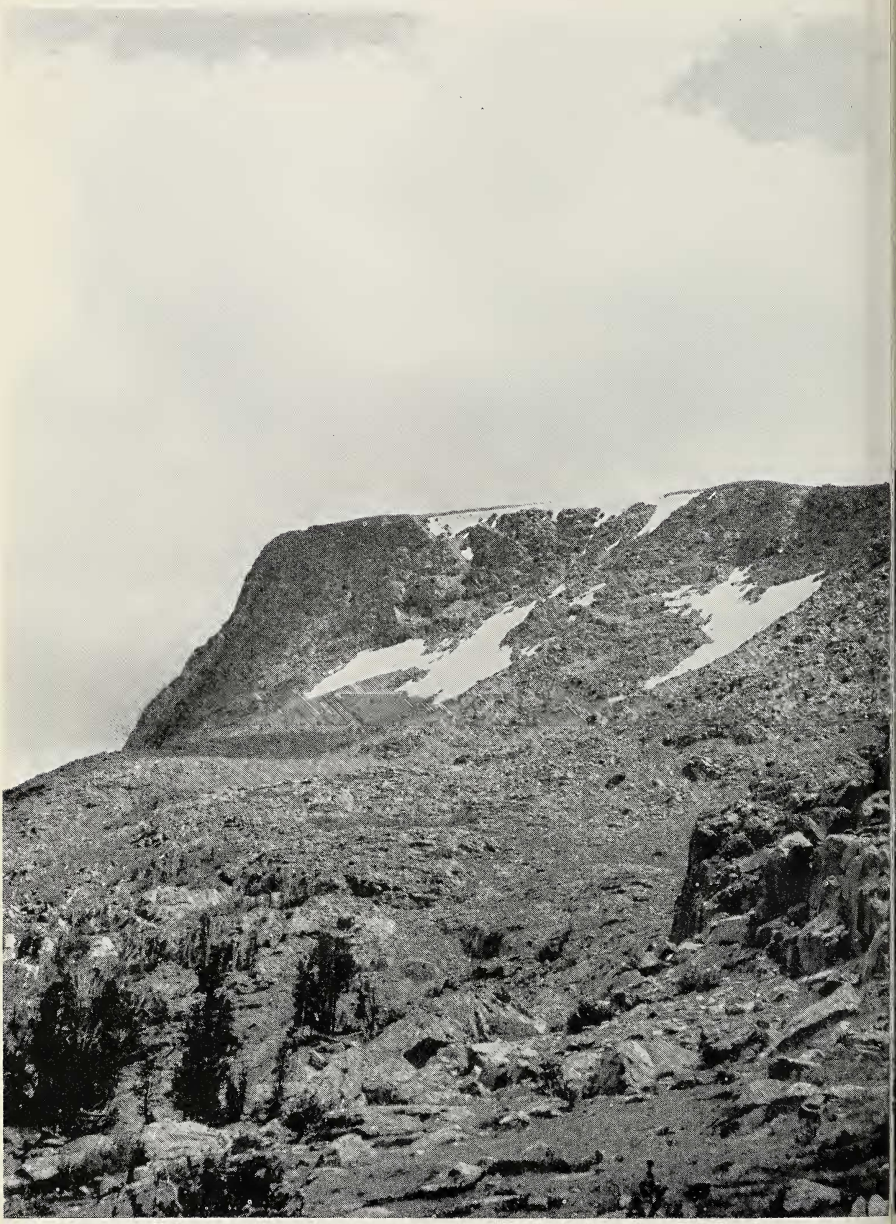


Fig. 6. Rocky slope habitat of *"hypophlaeas"* at N. slope Mt. Dana, Mono Co., California.

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BIBLIOGRAPHY

ANONYMOUS, 1962. Season summary. *News Lepid. Soc.*, no. 3, 14 pp. (p. 4).

ANONYMOUS, 1965. Season summary. *News Lepid. Soc.*, no. 3, 16 pp. (p. 12).

ANONYMOUS, 1967. Season summary. *News Lepid. Soc.*, no. 3, 17 pp. (p. 15).

BOISDUVAL, J. B. A. D., 1852. *Ann. Ent. France*, 2nd Ser. 10 (2): 291, no. 23.

BROWER, L. P & J. V. BROWER, 1954. The heredity of some spot aberrations in *Lycaena phlaeas* and *L. hypophlaeas*. *Lepid. News* 8: 125-129.

COMSTOCK, W. P., & E. I. HUNTINGTON, 1960. An annotated list of of the Lycaenidae (Lepidoptera, Rhopalocera) of the Western Hemisphere. *J. New York Ent. Soc.* 68: 176-186.

DAVENPORT, D., & V. G. DETHIER, 1937. Bibliography of the described life-histories of the Rhopalocera of America north of Mexico, 1889-1937. *Ent. Amer.* 17: 155-196.

DOD, F. H. W., 1907. Notes on *Chrysophanus hypophlaeas* and its allies, with description of a new species. *Canad. Ent.* 39: 169-171.

FERNALD, M. L., 1950. *Gray's Manual of Botany*. American Book Co., pp. 570-571.

FORBES, W. T. M., 1960. Lepidoptera of New York and neighboring states. IV. Agaristidae through Nymphalidae including butterflies. *Cornell Univ. Agr. Exper. Sta. Memoir* 371: 1-188.

FORD, E. B., 1923. The geographical races of *Heodes phlaeas* L. *Trans. Ent. Soc. London* 71: 692-743.

GARTH, J. S., 1935. Butterflies of Yosemite National Park. *Bull. So. Calif. Acad. Sci.* 34: 37-75.

GARTH, J. S., & J. W. TILDEN, 1963. Yosemite butterflies. *J. Res. Lepid.* 2: 1-96.

KLOTS, A. B., 1951. *A Field Guide to the Butterflies*. Houghton Mifflin Co., Boston, 349 pp.

LEES, E., 1963. Experimentally induced sexual dimorphism in *Lycaena phlaeas* (Lycaenidae). *J. Lepid. Soc.* 17: 105-106.

LEGGE, A. H., 1965. A collecting trip in Yukon and Alaska. *J. Lepid. Soc.* 19: 57-62.

LINNAEUS, C., 1761. *Fauna Svecica,* p. 285, no. 1078.

MAEKI, K., & C. L. REMINGTON, 1960. Studies of the chromosomes of North American Rhopalocera. 3. Lycaenidae, Danainae, Satyrinae, Morphinae. *J. Lepid. Soc.* 14: 127-147.

M'LACHLAN, R., 1878. *J. Linnean Soc. Zoology* 14: 111.

MOONEY, H. A., & W. D. BILLINGS, 1961. Comparative physiological ecology of arctic and alpine populations of *Oxyria digyna. Ecol. Mono.* 31: 1-29.

MUNZ, P. A., & D. D. KECK, 1965. *A California Flora.* Univeristy of Calif. Press, Berkelely and Los Angeles, 1681 pp.

NABOKOV, V., 1950. Remarks on F. Martin Brown's "measurements and Lepidoptera." *Lepid. News* 4: 75-76.

STARR, W. A., JR., 1956. *Guide to the John Muir Trail and the High Sierra Region.* James J. Gillick & Co., San Francisco, 131 pp., 1 map.

STRECKER, F. H. H., 1878. *Butterflies and Moths of North America, a Complete Synonymical Catalog.* Reading, Pennsylvania, p. 101.

TITE, G. E., 1957. On the typical subspecies of *Lycaena phlaeas* L., and the Scandinavian distribution of the species (Lepidoptera, Lycaenidae). *The Entomol.* 90: 37-38.

WOLFF, N. L., 1964. *The Lepidoptera of Greenland.* C. A. Reitzels Forlag, Kobenhaven, 74 pp., 21 pls.

WYATT, C., 1957. Collecting on the Mackenzie and in the Western Arctic. *Lepid. News* 11: 47-53.

YOKOYAMA, M., 1955. *Coloured Illustrations of the Butterflies of Japan.* Hoikusha; Osaki, Japan, 136 pp.

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